# SELECTIONS

FROM

# THE RECORDS

OF THE

# MADRAS GOVERNMENT.

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No. III. of 1855.

# NAVIGATION

OF

# THE GODAVERY,

REPORT BY LIEUT. HAIG, DATED DECEMBER 8, 1854;
WITH THE REMARKS OF THE BOARD OF PUBLIC WORKS THEREON,
AND A MEMORANDUM BY MR. TUKE.

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சரிபார்க்கும் முதல்வர் கையொப்பம்.
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No. 57.

DEPARTMENT OF PUBLIC WORKS,
*Madras, 15th January, 1855.*

FROM MAJOR J. H. BELL,
*Secretary to the Board of Revenue,*
*Department of Public Works.*

TO SIR H. C. MONTGOMERY, BART.,
*Chief Secretary to Government.*

SIR,

To Government, October 2nd, 1854, No. 779.
From Do. October 23rd, 1854, No 1360.
December 8th, 1854.

I am directed by the Board of Revenue, with reference to the correspondence as per margin, to submit a farther report from Lieutenant Haig, now Civil Engineer of Upper Godavery, upon the results of the examination of the river made by Lieutenant Goddard and Mr. Tuke.

2. Lieutenant Goddard commenced his levels at Koyenday, fifty-six miles from Dowlaiswaram, and carried them, with great difficulty, along the bed of the river, or the rocky and wooded banks, as far, it appears, as Bullanpoor on the Wurdah, four miles south of the large town of Chandah, and 450 from the Sea, or 411 from Dowlaiswaram. Both this Officer and Mr. Tuke are stated to have suffered many hardships during their arduous journey and operations.

3. After careful examination of Lieutenant Goddard's survey, and comparison of it with the map, Lieutenant Haig finds that the fall between Chandah and Dowlaiswaram, a distance of 415 miles, is 491 feet, or, on the average, one foot two inches per mile. But this fall is far from uniform. The river is in four distinct steps, formed by three barriers of rock, which are severally 4, 13 and 40 miles in length, (reckoning upwards from Dowlaiswaram) having falls severally of 36, 50, and 142 feet or 9 feet, 4 feet nearly, and 3½ nearly, per mile; the falls in the spaces between the barriers being consequently reduced to 10¾, 10¾, 8½ and 4½ inches per mile.

4. Lieutenant Haig proceeds to describe each space or reach in datail.

5. In the first one, whose length is 108 miles, and fall per mile 10¼ inches, there is, between Dowlaiswaram and Budrachellum, but little difficulty, the greater part having still water for several months in the year; but there are here, as in several other parts of the river, shoals of sand when the water is low, which render the fall irregular. Near Budrachellum commences a rocky reach, through which a passage may be easily made by blasting, which has been already successfully applied. There is also a whirlpool near Kutchaloor, formed by dykes of rock, which it will not be difficult to clear away.

6. The Central barrier, which forms the boundary of the first reach, is passable by boats in high freshes, but has a fall between the summer-levels above and below it of 36 feet. Its length is four miles, including a basin, and it is pierced by narrow winding channels, through which it is expected that passages for boats may be established by locking.

7. It is unnecessary for the Board to follow Lieutenant Haig farther in his detailed description of the river, the features of which already mentioned are repeated, with certain differences, in many other parts. The two remaining barriers are each more formidable than the first, from their greater length: but the reaches between them, respectively 76, 100, and 72 miles in length, are remarkably clear of rocks and open to navigation; and it is reported by the natives that the river has the same general character for 150 miles above Chandah.

8. Comparing Lieutenant Goddard's levels with the former barometric sections, Lieutenant Haig judges that the slope of the bed is certainly not more, and may be found to be less than he makes it. The quantity of water passing down at different points was not observed by Lieutenant Goddard and Mr. Tuke; but Lieutenant Haig himself ascertained it to be 3,00,000 cubic yards per hour at Koyenday, ten miles below the junction of the Sippery, in the height of an uncommonly dry season.

9. The principal, or at least immediate object in view, Lieutenant Haig observes, after concluding his description of the river, is to improve its navigation for a certain portion of the year, during which communication for commerce and other purposes may be carried on with safety and facility.

10. A lengthened discussion of the velocity of the flood-waves, and of the heights attained by the river at different times during the freshes, leads Lieutenant Haig to the conclusion that the first and second barriers are passable by large and loaded boats for about sixty days in

each year, extending through a period of four months; and that for another month it is possible that boats of very small size may pass. But these sixty days are not necessarily consecutive, and it is evident, therefore, that in the present state of the river, the navigation must be subject to such serious physical obstructions as to render it of little use to commerce.

11. Reckoning that the height of the river on the Dowlaiswaram register is really below 13¼ from the 1st July to the 31st of October, and that the volume of water continues much the same (though it cannot be accurately measured) for another month, Lieutenant Haig concludes that the problem to be solved is the opening of a passage through or round the barriers during this period, when they are impassable as often as the river is below sixteen feet at Dowlaiswaram.

12. Of three plans of effecting this object, Lieutenant Haig believes that one only, namely that of improving the present passages and placing lock-gates across them, is at present practicable and desirable for the two lowest barriers, which have first to be dealt with.

13. Lieutenant Haig does not anticipate serious difficulties in such operations, which, as he says, recommend themselves by their simplicity. It appears impossible, however, to form a correct judgment of their practicability at present, since the barriers have been far from accurately surveyed, and the passages may require an amount of work to render them navigable, much greater than might be expected from general considerations. All that can now be affirmed is, that there is nothing, in the abstract, objectionable in the plan, but, on the contrary, much that is promising. Lieutenant Haig's personal examination of the barriers will soon enable him to form a final opinion upon the proper measures to be taken; and they may safely, as they must necessarily, be left in his hands.

14. Should the plan prove successful, Lieutenant Haig anticipates that it would render the river navigable as far as the third barrier, (which it is proposed eventually to turn by a canal, as it is situated in a bend of the river,) for eight months in the year. 3

15. Lieutenant Haig's rough estimate for locking through the first two barriers, and for the canal with locks acrosst he bend where the third exists, amounts to thirty lakhs; and an additional amount, not yet estimated, will be required for the storage of water for effecting the distinct object, not intended by the present measure, of making the navigation practicable throughout the dry season. But the exploration

which he is now about to undertake, will doubtless lead him to fresh discoveries of the character of the river, and the species of operations and amount of outlay that may be required.

16. At present the Board have no particular proposition to make with reference to the very able report which they are submitting, but that it may be printed for general information.

I have the honor to be, &c.,

J. H. BELL,

*Secretary Board of Revenue, D. P. W.*

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No. 662.

Civil Engineer's Office,
Godavery Division,
*8th December* 1854.

FROM LIEUT. F. T. HAIG,

*Acting Civil Engineer, Godavery Division.*

TO THE SECRETARY TO THE BOARD OF REVENUE,

DEPARTMENT PUBLIC WORKS,

*Fort St. George.*

SIR,

I regret that, owing to various hindrances, I have not been able until now to report to the Board the result of Messrs. Goddard and Tuke's examination of the Godavery. I have now the honor to lay before the Board the information I have obtained from them.

2nd. They started from Dowlaiswaram on the 3rd March, and reached Koyenday, a village on the bank of the Godavery, about fifty-six miles above Dowlaiswaram, from which their levels were to commence, on the 6th. The loss of the stand of the levelling instrument detained them until the 2nd April, when another was received from Dowlaiswaram, and on the 3rd Lieutenant Goddard commenced levelling. The rocky nature of the banks, and the thick jungle which in most places covered them, greatly delayed this operation, compelling Lieutenant Goddard either to clear a way with his knife for almost every sight if he went along the top of the bank, or to wade through the water if he followed the bed of the river. After various delays, and suffering a good many hardships, being compelled for part of the time to leave their tent behind and to sleep under trees, they reached Bulhanpoor on the Wurdah, about four

miles South of Candah, and 450 miles from the sea, on the 7th June. At this point the rise of the river put a stop to all further operations, and after spending a short time at Nagpore they returned in a canoe by the river to Dowlaiswaram.

3rd. Lieutenant Goddard having devoted himself entirely to the work of levelling, Mr. Tuke took upon himself the duty of observing and recording the state of the bed of the river as they proceeded. A copy of his notes I have now the honor to forward for the information of the Board.

I will now state in detail the information regarding the state of the Godavery which we have thus obtained.

4th. In doing so I must make frequent reference to the map of the river, and it will therefore be necessary for me to premise that some doubt has been thrown on the accuracy of one part of it, that of the Vurdah, between Madeopore and Chandah. Messrs. Goddard and Tuke are inclined to think that it greatly exaggerates the length of this part of the river; but after considerable examination, and applying such test of its accuracy as these gentlemen could furnish, as the number of marches they went, and the length of each, between the two above mentioned places, and after a comparison of the map with others, my own conclusion is that it is tolerably correct.

5th. Assuming it to be so, the distance by the river from Dowlaiswaram to the mouth of the Wurdah, a little above Madeopore, is 235 miles; and from this point to Chandah 180 miles; altogether from Dowlaiswaram to Chandah 415 miles. The total rise in the bed of the river in this distance is 491 feet, which gives an average of 1f. 2in. per mile.

This slope is, however, as was to be expected, not uniform. It is broken into four steps, by three barriers of rock, which completely shut the river across at Cintral, Enchanepully, and Dawalamurry, the intercepted portions of the river being in length as follows.

1. From Dowlaiswaram to Cintral barrier... 108 miles.
2. From Cintral barriers to Enchanepully... 76 „
3. Enchanepully barrier to Dewalamurry... 100 „
4. Dewalamurry barrier to Chandah......... 72 „

The average fall of the bed in each of these reaches respectively, is, per mile, 10¾in. 10¾in. 8½in. and 4½in. and the total fall in each of the barriers, which are severally 4, 13, and 40 miles in length,—36 feet, 50 feet, and 142 feet.

4

6th. I beg to enclose a section of the river bed, which will make this description more plain. It has been taken almost entirely from Lieutenant Goddard's levels.

Referring to the map I proceed to describe each section of the river in detail.

1. From Dowlaiswaram to the Cintral barrier.

The length of this portion is 108 miles, the average slope of the bed 10¾in. per mile. At Dowlaiswaram the annicut dams back the water more or less above its natural summer level for a distance of about ten miles, to near the village of Komaradavem, where the natural slope of the bed commences and continues up as far as Devyputnum, where the river emerges from the Hills. From this point up to Koyenday, a distance of thirty miles, the river is for the most part confined between Hills, which at one place slope sheer down to the waters edge, at a distance of not more than 250 yards apart. The greatly reduced width of this portion of the river necessitates a corresponding increase of depth, rise, and velocity during floods; but for about half the year, when the quantity of water passing down is only from 400,000 to 1½ millions of cubic yards per hour, the great depth to which the bed has been scoured out in the freshes gives a section which requires scarcely any fall in this length of thirty miles to discharge the water. This piece of the river, from Devyputnum to Koyenday, is consequently almost still water for some months in the year.

7th. From Koyenday up to Budrachellum the rise in the bed is 63 feet, or at the rate of 1½ per mile. This slope is not, however, uniformly distributed; when the river is low, the shoals of sand which are constantly in motion form bars at intervals, the fall over which is somewhat above the average, and which consequently reduce the slope of the bed between them proportionably below it. This remark applies to every portion of the river bed when there is no great body of water coming down. I shall not therefore repeat it in describing other parts of the river, but merely observe that when I speak of an average fall in any part of the bed I mean that the slope is variable, but ranging between limits only a little above or below the average.

8th. Just above Budrachellum the first rocks in the bed of the river appear. They extend over a length of four miles, but are thinly scattered and may be easily removed by blasting. A great improvement in this part of the bed was, in fact, effected this year, by a small party under the command of a Naigue of Sappers, who cleared a good pas-

sage right through with the expenditure of only about 100 lbs. of powder. This rocky reach is the only obstacle to be met with between Dowlaiswaram and Cintral. During floods the rocks are quite covered, and offer no impediment to the passage of boats, though, until this year, the channel was intricate at certain heights of the river.

9th. I must not, however, omit to mention the two dykes of rock which project from the side of the hill which forms one bank of the river near the village of Kutchaloor, and which, though they scarcely reach the water edge when the river is low, during floods obstruct the current, which from the shape of that portion of the river is strongest on that side, and cause a very dangerous whirlpool in rear of them. A portion of them has already been removed, and they may easily be entirely cleared away.

10th. The Cintral barrier, a sketch of which, copied from one drawn from memory by Mr. Tuke, is herewith sent, is the first that is met with in ascending the river from Dowlaiswaram. It extends over a length of altogether about four miles, according to Mr. Tuke, whose measurements I have followed in this case, but according to the map over a much longer distance. It consists of two separate masses of rock, of one and two miles in length respectively, which enclose a basin of three quarters of a mile in length, tolerably free from rocks, between them.

In the summer the difference of level between the water immediately above this barrier, and that below it, is 36 feet. When the river is full it passes clear over the whole of the rocks, and though the current is great, boats may then ascend it. But when the water falls to the summer level, the tops of the rocks are uncovered, and become thickly overgrown with grass and bushes, the water then coming down finding a passage for itself by two narrow winding channels which it has worn, one on each side of the river, through the rocks. These narrow passages vary from twenty to thirty yards in width, and from ten to twenty feet in depth. They extend through both upper and lower portions of the barrier. That on the left bank is worn so clear that the water finds a tolerably free passage through it; that on the right bank terminates abruptly at the lower end of the barrier in a steep ledge of rock, over which the water falls about eighteen feet in height.

11th. The width of the river at this place varies from 600 yards at the lower end, to 1,000 at the upper. The banks are about sixty feet high about summer level below the barrier, and rise slightly towards the upper end of it, when they are about twenty-two feet above the tops of the rocks in the bed.

5

This barrier is thus a natural annicut, which dams the river up to a height of thirty-six feet.

12th. The next section of the river extends from the top of the Central barrier to Enchanepully, the distance being seventy-six miles, and the average rise of the bed 10¾in. per mile.

Mr. Tuke's notes show that, at a few places in this interval, detached rocks occur, but they may be easily removed, and none of them require particular notice.

The height of the bank varies from fifty to sixty feet, and the width of the river from 500 to 2,000 yards.

13th. A little below Enchanepully the 2nd barrier begins. The river at this point takes rather a sharp turn to the eastward, and from near the village of Talagoodem, the bed begins to be studded on both sides with rocks, which gradually increase in number, till near the village of Enchanepully they almost shut the river across, the only passage for the water, in the summer, being a narrow winding one,* about thirty yards in width, and twenty to twenty five feet in depth, which the ceaseless action of the water through a course of ages, has worn through the rock. This channel is described by Mr. Tuke as having the appearance of having been cut by the hand of man, so regular is it, and so smooth and even its sides—above it the rocks continue, though more thinly scattered, for about four miles, where a narrow ledge, over a low part of which the water falls about two feet in summer, crosses the river. Five miles higher up, at the village of Damoor, the principal barrier commences. The river is here completely shut across by a solid mass of rocks, which rise from eighteen to twenty-five feet above the summer level, the water falling over them in the most picturesque manner. At the time Mr. Tuke passed them, the fall of the water was not more than four yards in width, so small a quantity was then coming down. This mass of rock extends for a few hundred yards above where the overfall is, beyond which, for about one and a half miles no rocks are to be seen. There, at the village of Punkina, a narrow ledge crosses the stream, and over it there is a clear fall in summer of about six feet.

* Vide Map.

14th. The total length of this rocky part of the bed, viz. from Enchanepully to Punkina, is about twelve miles, of which however seven miles have a good passage through the rocks. The total fall in this distance, the difference of level between the water above the rocks at Punkina and that at Enchanepully, is fifty feet.

The rock is mostly slate.

The width of the river varies from 300 to 500 yards, and the height of the banks above the summer level from sixty to seventy feet.

15th. In the sketch of this barrier which accompanies this letter, and which has been copied from one drawn from memory by Mr. Tuke, the portion of it between Damoor and Punkina is not shewn, as the Punkina rocks were not considered as part of the barrier, but rather as forming a second one. They are, however, I have no doubt, all part of the same mass of rock, the intervening space of two miles between Punkina and Damoor having a rocky bottom covered over with sand.

16th. The third section of the river is from Punkina to Deevalammurree, where the third barrier begins.

All this part of the river, in length 100 miles, is clear. Here and there a very few isolated lumps of rock appear, but may be easily removed.

The average rise of the bed in this distance is 8½in. per mile, the total rise being seventy feet; of which, it will be observed, twenty-five feet are in a distance of sixteen miles, between Punkina and Madeopore, —which makes the fall per mile in this short distance one and a half feet per mile. This is quite possible, as the quantity of water coming down at the time the levels were taken was exceedingly small, being only a stream about twenty yards in width and twelve inches deep—so shallow a stream would have no power to equalize the slope of the bed. From Madeopore upwards a long reach of almost still water extended, with this fall of one and a half feet per mile just below it. I need scarcely remark that, with such a body of water going down as it is proposed to throw into the river from reservoirs in the dry weather, such variations in the slope of the bed would not occur. The slope at any one point would then but little exceed the average.

17th. About sixty-six miles above Madeopore a small tributary called the Bibbera river joins the Wurdah; it was not examined by the exploring party, but was described by the country people as being quite clear of rocks. About fifteen miles up is situated a cotton mart, named Jernagaum; Messrs. Tuke and Goddard did not visit this place, which is to be regretted, as some valuable information might have been obtained there.

I find it recorded in "Notes of a Geological Tour between Hydrabad and Nagpore" in the Madras Journal of Literature and Science,

that this river is remarkable for the hot calcareous springs that are found along it. Its interest to us in our present undertaking is of another kind, as I shall presently explain.

18th. Near Sironcha, on the left bank of the Wurdah, is the spot where the late Dr. Bell dug for coal, and, it is said, with success. That it exists there, though perhaps at some depth beneath the surface, there can be no doubt, from the black shale which is found in such quantities.

It is much to be regretted that Messrs. Goddard and Tuke did not visit this most interesting spot, and bring away some description of it. I should above all things have wished to be able to give the Board some information respecting it, and I hope to do so before long. Mr. Roberts is at present engaged in sinking a shaft there, but the last rise of the river covered the ground and filled the pits, and has impeded his operations a good deal. The natives there state that Dr. Bell found good coal at a depth of forty feet, but their account of it is, of course, not deserving of much credence. One of our first operations should be to have a thorough examination made of this spot, and of the surrounding country.

19th. The 3rd, and most formidable barrier, commences about a mile above the village of Deevalamurree, and extends over a length of forty miles of the river. In Captain Fenwick's map this portion of the river is shewn as free from rocks except in two or three places, but he saw the river only in the monsoon, when it was full, and his map, therefore, represents it in that state. The whole of the length of forty miles is described by Mr. Tuke as a solid mass of rocks. When the party passed it in May it was quite impassable to boats. Near the upper end of it, which is about a mile above the village of Daroor, a portion of the barrier ends abruptly, in a step of about fifteen feet in height, over which the water has a clear fall in summer.

I have not had a sketch made of this barrier.

20th. At first sight, this forty miles of rock certainly has a very unpromising appearance. For the monsoon passage it is, however, the least formidable obstacle to the navigation, of any of the barriers. The total fall in it is 142 feet, or at the rate of three and a half feet per mile; whereas the Enchanepully barrier has a fall in one part of eight feet per mile, and that at Cintral of nine feet. And as with equal volumes of water, the depths over each vary inversely as the slope, it follows that the part of the river just described must be navigable at times when the other two barriers are impassable. So that for the monsoon navigation

of the river, there is really much less difficulty in ascending this part of the river, than at either Enchanepully or Cintral. Accordingly, we find it, as I have said, described in Captain Fenwick's map as comparatively clear and open. While, however, our first object is to open some sort of a passage up the river during the months when it is in flood, we have also to consider the practicability of making it navigable all the year round. I shall presently point out, when I come to consider the question of how we are to deal with the barriers, the particular facilities which appear to exist at this point for avoiding this one.

21st. The 3rd and last section of the river, which I have yet to describe, is from the top of the Deevalamurree barrier at Daroor to Chandah. There is scarcely a single rock to be seen in all this length of seventy two miles. The slope of the bed is only four and a half inches per mile. The exploring party did not examine the river above Chandah, but as far as the eye could reach it appeared to be perfectly clear, and they were told by the natives that no rocks are to be met with as far up as Nutchengaum, which is 150 miles above Chandah on the Wurdah. This last piece of information seems almost too good to be true.

22nd. Such, from all the information we have obtained, is the present state of the Godavery, and its tributary the Wurdah, up as far as Chandah, 450 miles from the sea.

23rd. Of the accuracy of the levels we have two tests, not very reliable ones perhaps, but sufficient for our present purpose. In the Barometric sections of India, the ground on the back of the Godavery near Hingenghaut is stated to be 650 feet above the sea, that at Nutchengaum 715 feet. The former place is 100 miles, by the river, above Chandah, the latter 150 miles. Chandah is, according to Lieutenant Goddard's levels, 490 feet above the level of the water at the annicut.

Add 35 the height of that water above the sea.

525 Chandah above the sea.

River bank near Hingenghaut is 650f. above sea.

d. d. for height of river bank above bed, probably 40

Bed of Godavery near Hingenghaut..............610

Do. Do. Chandah.........................525

85

•Rise in bed from Chandah to Hingenghaut......... 85

Distance 100 miles—

Fall per mile, $10\frac{1}{2}$ inches.

| | | |
|---|---|---|
| 2. Bank of Godavery at Nutchengaum, | 715 | above sea. |
| d. d. height of bank | 40 | |
| Bed at Nutchengaum above sea | 675 | |
| Do. Do. Chandah | 525 | |
| Distance 150 miles— | 150 | |
| Fall—1 foot per mile. | | |

I am not quite certain about the distance. The fall which the above calculation shews for the bed above Chandah, is below the average of that below that place, which is one foot two inches per mile. This is possible, but does not seem probable, as we should rather expect to find the slope of the bed increase towards the source. If however the Barometric level is to be trusted, it seems to prove at least this, that Lieutenant Goddard's levels are not *below* the truth, that the slope of the bed is not *more*, and may be *less* than what he makes it.

So far the test is satisfactory.

24th. It would have been a matter of much interest to have ascertained, by careful measurement, the quantity of water passing down the river at different points of its course, and at different times in the hot season. Had this been done, we should have been able to form a better idea of the quantity of water it will be necessary to throw in from reservoirs, to maintain a good navigation during the summer months.

Mr. Tuke has noted the width and depth of the stream at one or two places, but not with any degree of accuracy.

Having no definite object in view when his observations were made, he has omitted to notice one or two points, without a knowledge of which no satisfactory conclusion as to the discharge of the river can be deduced. He passed the Enchennepully barrier in May, and then observed that a very much larger body of water was coming down the Indravutty, than down the main river above the point where this tributary joins it. The Godavery proper, above the junction of the Wurdah, was almost dry, the whole of the water there flowing to the sea being supplied by the Wurdah and its branches and the Indravutty, and the greater portion of it by the latter river. As I said, however, no observations were made with express reference to this subject.

25th. I myself went up the river along with Lieutenant Stewart, in the beginning of June, as far as Koyenday, for the purpose of ascertaining the actual discharge of the river at that point, which is ten miles below the junction of the Sippry, the last of the tributaries, with the

Godavery. We found, by careful measurement, that the quantity of water passing that place was 300,000 cubic yards per hour, which agreed with similar observations made by Major Cotton at Dowlaiswaram. This was in the very height of the hot season, when there was less water in the river than we had ever known before. I record the fact, as it will be useful hereafter, when we come to discuss the best means of keeping up the navigation of the river in the summer months.

26th. We have then to deal with a river several hundred miles in length, and with a width of from 250 to 2,000 yards. Its average slope is one foot two inches per mile; but the part of it with which we are as yet acquainted is intersected by three barriers of rock, which considerably reduce the falls of the portion of the river between them.

Its floods rise from thirty to one hundred feet above the summer level; and its discharge varies from 200,000,000 of cubic yards per hour, in extreme floods, to about 300,000 cubic yards in the hottest weather. It is known to be navigable when in flood, that is during portions of four months in the year; but at all other times communication by it is intercepted.

27th. We have at present two objects in view respecting it.

1st. To improve the present monsoon navigation.

2nd. To make the river navigable all the year round.

The two objects are quite distinct, and may be separately considered. The 1st is of by far the greatest importance, as it may be most easily and quickly effected, and will give us what the country most urgently requires at present, a tolerably good communication with the interior, though it be only for a small portion of the year. If, in a short time, we can make the river navigable for large craft during five or six consecutive months of the year, our principal object will have been gained.

28th. I proceed then to consider to what extent this is practicable. It is essential that we should first of all ascertain, with some degree of certainty, for how many days in the year the river may now be navigated; at what heights of the flood, and in what states of the river, the barriers are passable.

29th. Captain Fenwick states that he considers the navigation practicable for boats of a certain description for eight months of the year, *viz.* from June to January inclusive. He mentions having made trips down the river from Woonie, on the Wurdah, to Coringa, during those months. The boats he used were of considerable size. I cannot, however,

in any way reconcile this account with the facts ascertained last year by Major Cotton, in his voyages up the river. It appears certain, from the observations then made, that two of the barriers are only passable for boats when the river is at a height, which it never attains at any other times of the year, than from July to October inclusive. It is possible that very small boats might, with great risk, pass these dangerous places during another month, but even allowing this, we should have only five months instead of eight, during which the river is navigable in its present state. Without attempting to account for this discrepancy, I think it better at once to state what we know for certain on this subject, and my own conclusions therefrom.

30th. The Board are aware that a register of the height of the water daily in the Godavery, has been for some years kept at Dowlaiswaram and Rajahmundry. From it, it is easy to reckon the number of days in each year, at which the river remains at, or above any particular height.

It is known also that a flood in a river is simply a wave, which travels down with a velocity, which has been ascertained to be considerably less than that of the current of the river.

To know the rate at which this wave moves, it is only necessary to observe the dates on which the flood reaches its greatest height at any two points along a river; and then supposing these points to be a good distance apart, and that the river between them receives no considerable tributaries in its course, the distance between them, divided by the difference between the dates of observation, will give the rate per day at which the flood wave moves.

Having ascertained this, and having a register of the rise and fall of the river on a standard fixed at any one spot, we may, by observing the date on which the flood reaches a certain elevation at any point higher up the river, deduce approximately the height corresponding to that particular stage of the flood on the standard below.

31st. I find, from the log of the *Pottinger* on her voyage up to Enchanepully last year, that the flood reached its greatest height when the Steamer had arrived at a point 150 miles above Dowlaiswaram, on the 21st July. The Dowlaiswaram register shews that the same flood was at the highest here on the 23rd. The flood wave must therefore have travelled at a velocity of 150 miles in about fifty hours, or at the rate of three miles per hour, which is a little less than half the mean velocity of the whole mass of water. This proportion between the rate of

progress of the flood and the current of the river, corresponds nearly to that observed by Mr. Ellet in the Ohio, as recorded in his work on the Mississippi.

32nd. On the 29th of July the Steamer grounded on a bed of rocks near Enchanepully; and on the 2nd August Major Cotton and Mr. Tuke, who had in the meantime proceeded some miles up the river to reconnoitre, came down the river on canoes, passing the worst part of the barrier. They found the passage very intricate and dangerous even for canoes. It was therefore not practicable for large boats. On the 30th July however, when the river was six or seven feet higher, Mr. Tuke considers that a steamer might have got over the rapids. Allowing that the progress of the flood wave was the same at this height of the river as when in full flood, the corresponding height on the standard at Dowlaiswaram would be that of the 31st, when the river stood at sixteen feet.

Again, the log of the same voyage records, that on the passage up, when they had reached the village of Doomagoodem, which is about half way up the Cintral barrier, the upper portion of the barrier was found by Major Cotton and Mr. Tuke, on examination, to be impassable, the current being greater than the Steamer could stem. This was on the 11th. The corresponding height at Dowlaiswaram was seventeen feet. The day after, the steamer was got over the rapids; the height corresponding to that date on the Dowlaiswaram register being eighteen feet.

33rd. These are facts from which we may draw some conclusion as to the time during which the navigation past these two barriers is practicable. We may, I think, infer from them, that in the present state of the bed, the river is navigable between Dowlaiswaram and Madeopore, only when the water stands at or above the sixteen feet mark on the Dowlaiswaram register.

34th. The following is an abstract of the registered heights of the river between the limits of fifteen and 20 feet above the annicut, during the last four years.

| In the year........................ | 1851 | 1852 | 1853 | 1854 |
|---|---|---|---|---|
| The river stood at a height of not less than 20 feet on the Dowlaiswaram standard for........................ | Days. 12 | Days. 31 | Days. 29 | Days. 21 |
| 18 feet........................ | 20 | 42 | 38 | 38 |
| 17 feet........................ | 26 | 50 | 44 | 50 |
| 16 feet........................ | 47 | 65 | 56 | 57 |
| 15 feet........................ | 60 | 75 | 84 | 82 |

I should explain that each of the numbers in this table represents the *aggregate* number of days that the river stood at or above a certain height; and not that it remained at that height for so many consecutive days.

The table embraces a period of a little more than four months, or about 130 days, viz. from the latter end of June to the end of October, which includes the whole of the flood season, and it will be observed that the greatest length of time at which the river remained at any one elevation, namely fifteen feet, was eighty-four days, or about two-thirds of the whole period. The fluctuations in the height of the river are of course constant during the these months, and not only the total number of days during which the river remains above any particular height, but also the number of consecutive days in which it maintains that height, are less in proportion for equal increments of elevation of its surface.

In the present year for instance, the number of days between the 1st July and 31st October, at which the height of the river on the standard was not below twenty feet, were

12—— 9—— 0—— Total... 21

and the intervals during which it remained below that mark, were

22——40——40—— Total... 102

For the 16 feet height, the corresponding number were

| | | | | | | |
|---|---|---|---|---|---|---|
| at and above 16 feet | 26 | 28 | 8 | | | = 62 |
| below Do. | 16 | 25 | 6 | 14 | | = 61 |

It is to be wished that the register had extended over a greater number of years than it does. It has been kept at Dowlaiswaram since 1847, and at Rajahmundry since 1842, but the building of the annicut having deranged the summer level, I am unable to compare the register kept since that work was completed, either with that made while it was in progress or before it was begun.

35th. Of the four years under review, the 1st, or 1851, was one in which the floods of the Godavery were so unusually low and few in number, that a fair average of the whole could not be struck if it were included. Taking the average of the other three, we find that the river remains above the sixteen feet mark for about sixty days in the year. Consequently, from what we have seen above, the Enchanepully and Cintral barriers are passable by large and loaded boats only during that time. Of the highest or Deevalamurree barrier, we know nothing with respect to its state at different heights of the

river. We know, however, that the fall per mile in it is not more than that in the Enchanepully, and less than that in the Cintral barrier, and we may very safely conclude that that portion of the river must be navigable as long as the other two are.

36th. As regards, therefore, our first point of enquiry, how long the river is navigable in its present state, my conclusion is that it is so at certain times during four months of the year, but that for another month it is possible that the navigation may be open for boats of very small size, which could be taken past diffcult parts of the river which would be impassable for larger craft.

I have thought it right to enter thus far into detail on this subject, that the Board may be enabled thoroughly to understand the grounds on which my conclusion is based, and also that Major Cotton, who has had the great advantage of seeing the river at different times of flood, may have the means of judging how far the opinion I have expressed as to the practicability of passing the barriers in certain states of the river is correct.

37th. The only room for error that there appears to be in the mode of calculation I have followed, is in my reckoning the rate of progress of the flood wave to be the same at all stages of the river; and also that I have taken no notice of the fact that the Sappry, a small tributary, joins the Godavery between the point where the highest rise of flood was observed and Dowlaiswaram.

It is probable that the velocity with which the flood wave moves may vary with each particular height of the flood. It seems likely that it would increase as the river fell, but the variation is probably not much, and it would only make a difference of a few hours in the calculated time, which for our present purpose is of no consequence.

38th. As regards the possibility of the occurrence of a sudden flood from the Sappry between the 29th and 31st July, the dates of observation at Enchanepully and Dowlaiswaram, it must be remembered that if such a thing did take place, the volume of the river, then in full flood, would probably not be much increased by it, as the Sappry is one of the smallest of the tributaries; and also that the register at Dowlaiswaram does not indicate any very sudden rise between the dates mentioned.

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For our present purpose, therefore, I think we may regard the above calculation of the time during which the river may be navigated in its present state as correct.

39th. We have next to consider the best and readiest means of improving this navigation, so as to make it practicable during the intervals in the monsoon months in which it is now interrupted, and, if possible, for all that portion of the year during which the quantity of water in the river is sufficient, in an open bed free from obstructions, to afford good navigation.

Our object is not to perfect the communication for a small portion of the river, but to improve the whole length of what already exists to such a degree, as we may find time and means for in each working season.

40th. The present obstacles to the navigation are the three great barriers of rock which I have described. To the improvement of the passage through them, our first efforts must be directed. To whatever degree we succeed in doing this, to that extent we improve the navigation of the whole river.

In saying this, I take no notice of the numerous clusters of detached rocks which are met with in other parts of the river. They are so easily removed to any required extent by simple blasting, that they cannot be looked upon as any serious obstacles, and need not be taken into account.

41st. It appears from the Dowlaiswaram register, that between the 1st July and 31st October, there are not more than from six to ten days, in average years, in which the water falls below thirteen feet six inches on the standard.

It is probable, also, that the volume of water in the river corresponding to this height, does not much diminish till about the end of November, but I cannot be sure about this, as the shutters are generally placed on the annicut in the beginning of this month, and the water kept up by them above the level, which, if allowed to run freely off, it would otherwise stand at.

42nd. To maintain, therefore, a constant navigation during five months of the year, would require that we should make good the passage through the barriers, when the river has fallen to thirteen and a half feet at Dowlaiswaram, or to two and a half feet at that place below the level (sixteen feet) at which we consider the river to be now navigable.

43rd. I am inclined to doubt the possibility of our accomplishing this by merely blasting passages through the barriers. We can, of course, cut a channel in this way wide enough and deep enough to float any boat, but from what we know of the fall per mile in two of the barriers, those

of Cintral and Enchanepully, I fear the rush of water down these artificial channels, would be greater than any boat could stem, even if assisted by track ropes.

It must be remembered that a fall of two and a half feet, viz. from sixteen to thirteen and a half feet, in the river at Dowlaiswaram, indicates much more than appears at first sight.

The discharge of the river in the one case, would be more than six times that in the other.

The overfall at a barrier, that is the difference between the level of the water above and that below it, would consequently be immensely increased, and the velocity of the current such as no steam-boat or other boat could overcome.

44th. If Mr. Tuke's judgment of the distance in the Cintral barrier is correct, the upper portion of it has a fall of nine feet per mile, and the lower of as much as eighteen feet. The upper part of the Enchanepully barrier also has about the same fall. When the river is full, of course this slope is reduced to a small fraction of what it is in the dry weather; but it rapidly increases for every foot the river falls. At the thirteen and a half feet level, the velocity of the current through Channels cut artificially through the bad part of these barriers, would, I think, not be less than ten miles per hour, which, in a narrow channel, would be almost impracticable for large boats.

45th. For these reasons I do not anticipate the same degree of improvement to the navigation, from simply blasting passages through the rocks, that I formerly did, before I was properly acquainted with the actual nature of the obstacles to be overcome.

46th. It must, however, be remembered that we are not yet in possession of all the information necessary to enable us to form a correct judgment in this matter. Had careful sections of the barriers been taken, and had we known the depths observed on them at certain heights of the river, and the overfall at those times, we might have correctly estimated the probable effect of opening or improving passages through them.

As it is, I would again remind the Board, that though the difference of level between the water above and below each barrier is shewn by Lieutenant Goddard's levels, the shape of the barriers themselves, as represented in the plans which accompany this letter, has been drawn from memory only by Mr. Tuke; and that in the case of the Cintral, which is apparently the worst of all, the map makes the length of it about double what he considers it to be. Mr. Tuke is, however, so positive as

to the correctness of his own estimate of the distances, that I have followed his description of this part of the river in all that I have said.

47. The question, then, of how best to deal with these rocky obstacles, is one of more difficulty, and requiring more consideration, than appears at first sight.

I do not see that they are of much use to us as annicuts, as might be supposed, by damming up the river to such a height as they do, and so reducing the slope of the bed above them to a certain extent.

They are too few in number, and too far apart to be of any advantage in this way.

The Cintral barrier for instance, keeps up the water, in summer, thirty six feet above what it would be if the barrier were not there, and reduces the slope of the bed between it and the Enchanepully barrier, the one next above it, to ten inches and a half per mile, the distance being about seventy-six miles. But this slope is not uniform. Just above the lower barrier it is almost on a dead level for some distance, and thence, upwards, gradually increases, till for a great portion of the distance it fully equals the average slope of the whole river.

It would require, therefore, just as much water to keep this part of the river navigable, as if the whole length of the bed had one uniform inclination.

Annicuts, to be of any advantage in this way, must be of sufficient number, and at such distances apart, that they shall affect the slope of the whole length of each part of the river.

48th. For a similar reason I do not see that we should gain any advantage, by raising the height of each barrier by an annicut thrown across it. Such a work would be of very simple and easy construction, but the difference of level between the different barriers, is too great to be affected in any thing more than an insignificant degree, by the greatest height of annicut we could raise upon each of them.

It is quite probable that some of them may be turned to account for irrigation purposes; but that is a matter for after consideration, and foreign to the question in hand.

49th. It appears to me, therefore, that these barriers are to be regarded simply as obstacles, which we can turn to no good account for navigation, but must get over the best way we can.

There appear to be three ways of dealing with them.

Either, 1—To cut a passage through each of them, of such slope and dimensions as that it shall be navigable at all times of the year.

Or, 2—To improve the present channels through them, so as to make them practicable for a longer period during floods, and to avoid them at other times by a canal cut round them in the bank, and furnished with the requisite locks.

Or, 3—To improve the monsoon passage, as in the last case, but to place the locks in the barrier itself, making use for that purpose of the channels which already exist in them.

50th. In this, pre-eminently above all other questions connected with the improvement of communication in this Presidency, *time* is the important element. When such enormous sums are yearly lost for want of a proper communication between Berar and the Coast, we may set the question of expense quite aside, in the consideration of how we may most readily and speedily improve the Godavery navigation.

51st. The next and most important thing to be borne in mind in the consideration of this question, is the shortness of our working season, in consequence of the work being almost entirely in the bed of the river, when it mnst always be stopped by the first rise in the beginning of June; and, secondly, the unhealthiness of the localities we shall be obliged to work in, and which, as far as we yet know, will prevent our commencing even to ascend the river before the 1st of February.

In that thinly populated country, too, we cannot reckon on collecting any considerable number of labourers at any one spot.

52nd. Such being the case, that method of getting rid of the present obstructions to the navigation recommends itself the most, which requires least labour on the spot, and can be the most quickly affected. Keeping this in mind, we may now try how far each of the three plans I have proposed will fulfil the necessary conditions.

53rd. 1. In the Cintral barrier. To enlarge one of the two channels that now pass through it, to a width of only thirty yards, and cut the floor of it down to a slope of two feet per mile, would require the removal of about one million cubic yards of rock, which would not cost less than two lacs, and would take 1,000 men for ten years, or 2,000 men for five years, to complete it, reckoning 100 as the average number of working days in the bed of the river in the year, and that a large portion of the workmen and men are well trained and accustomed to quarrying.

I think it unnecessary to give the details of this calculation. It is simple, and in making it I have allowed about three annas per cubic yard as the cost of quarrying, which includes sundries and contingencies, and that, on the average, a man will quarry and remove a cubic yard of

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rock daily, which is what we find to be the average in the Dowlaiswaram quarry.

A channel of these dimensions would have a depth of about eight feet when the volume of water passing through it was 500,000 cubic yards per hour, which is what we may suppose to be the quantity required to keep the open parts of the bed navigable all the year round. The surface velocity at this time would be about four and a half miles per hour, but this would be the lowest it would ever have. At certain heights of the river the velocity would be that due to a slope of probably six feet per mile, and a depth of forty feet, which would be about thirteen miles per hour.

This alone would be a decisive objection to a channel of this small size. To widen it, would be to increase the main difficulties connected with this plan of improving the barrier, namely the length of time and the number of men it would require to complete it, to say nothing of the cost.

54th. Another difficulty that besets this plan is, that during some of the summer months, the whole of the water coming down the river would be discharged by the proposed channel through the rock. Its surface level above the barrier would, consequently, be regulated by the depths in this channel; and these gradually diminishing to eight feet at the head of the channel, when the discharge was only 500,000 cubic yards per hour, the surface level at that point would be twenty-eight feet below the lowest it ever falls to in the present state of the river. The consequence would be, in all probability, the uncovering of an immense extent of rock, now covered over with sand in the bed above the barrier, which would require a similar cutting to be made through it also. We know little of the geology of that part of the country, but it is possible that the Cintral barrier may be merely a portion of a great dyke of volcanic rock, which has been protruded, and is crossed by the river at nearly right angles at that point, and that consequently the bed of the river above it, up to Enchanepully, may be comparatively free from rock. But it is still more probable that the detached lumps of rock, which shew themselves here and there along this part of the bed, are simply the most prominent points of extensive masses, now concealed under the sandy bed of the river.

I have thought it as well to notice this plan, because it is the first that occurs to the mind, and its inapplicability can only be shown by a detailed examination of it.

55th. With the Enchanepully barrier the case would be much the same. In the Dewalamurree, or highest barrier of all, its great length would of course preclude all thought of dealing with it in this manner.

56th. The 2nd method that suggests itself, is to improve the monsoon passage, so as to make it practicable until the velocity of the current becomes too great for boats to stem, and to cut a channel round the barrier, a short distance in from the bank of the river, with locks for boats to pass round this way when the river route is impracticable.

57th. I may at once state that this plan appears to be the only feasible one, in the case of the upper, or Dewalamurree barrier. This is forty miles long, but it will be observed, on reference to the map, that it lies in a great bend of the river, which, from its commencement at Chematum, to its upper end, about eight miles north-west of Sirpoor, is ninety-six miles in length. A canal, connecting the two extremities of this curve by a straight line, would be only thirty-five miles long, and would consequently save sixty-one miles of distance, besides avoiding the whole of the rocks. We know so little of the *shape* of the country there, that it would be useless to attempt to form any kind of estimate of the probable cost of such a canal. Nor is it necessary to do so, as we can have very little doubt that, whatever it costs, it will be by some such work that this rocky reach of the river will be avoided.

The Bibbera river, a small tributary which joins the Wurdah at Jillera, runs in a direction which would be very suitable for a canal across the narrowest part of the rock of this bend. It was described to Mr. Tuke as quite open and free from rocks; and in case of hilly ground intercepting the other line which I have proposed, would apparently offer remarkable facilities for the construction of a canal.

58th. To lock, in this way, round the Cintral barrier, would require an excavation ten yards in depth, and not less than twenty at bottom and fifty at top, for a length of rather more than four miles. The quantity of earth work would thus be about 1,230,000 cubic yards, which, supposing that no rock were met with (though it is most likely that the lower two yards would be rock), and allowing two cubic yards per day per man, on the average, would take 2,500 men five years, or 1,200 men ten years, besides those required for the construction of the masonry works. These, though heavy, probably not less than 50,000 cubic yards content, might perhaps be completed the 3rd working season; but the possibility of collecting 1,200 coolies in any one spot in that part of the country seems doubtful. The Enchanepully barrier would probably re-

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quire the lock channel to be not less than six miles in length, and a proportionately greater time would be required for its completion.

We are, however, as yet quite in ignorance of the number of men we could get for these works; but with so short a time, only four months, for the people to collect in, and in such a very thinly populated country, the largest town in which probably does not contain four hundred houses, there does not seem much prospect of our being able to collect any considerable number of men in one place.

I am, perhaps, allowing too short a length of working season for earthwork. Probably the natives would gladly work there for some months longer, but we should have difficulty in superintending them if, as is supposed, the prevalence of fever makes it dangerous for Europeans to remain there except during four or five months of the year.

The only objection to this plan of locking round the barriers is the time it will require. It is evident that it would effectually remove the difficulties of the present navigation.

59th. The 3rd and last plan that I have proposed, and the one which, if feasible, seems by far the most preferable, is to improve the monsoon passage over the barriers as before, and to place the locks in the barriers themselves.

The extreme simplicity of this plan, and the short time in which it may be accomplished, are its great recommendations.

60th. In the Cintral barrier there are already two narrow channels through the rock, one on each side of the river. Their width is probably even now quite sufficient for river boats of the largest size to pass through them, supposing there to be either very little or no current in them, and it would take very little money to widen them a few yards more if necessary.

The one on the right bank might be chosen for our purpose. The rocks on that side are considerably higher than on the other, and would probably be bare when the others had two or three feet of water over them.

The barrier is in two portions, the upper one two miles, and the lower one mile in length, with about a mile of nearly open bed between them.

In summer, when the river is at the lowest, the difference of level between the water above, and that below this barrier, is thirty-six feet, which is nearly equally divided between the two parts of the barrier. A lock of eighteen feet lift might then be placed at the lower end of the

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right side passage in the upper barrier, and one of similar dimensions in the same position in the lower.

All that would be necessary for this purpose would be to smooth the rocky sides of the lock chamber with the crowbar, cut out a place for fixing the still stones of the gates, if it were not easier to cut the sills themselves in the solid rock, shape the sides so as to receive the gates, and then hang the latter, and the work would be done. It might be more expeditious to blast more freely, and then build up with cut stone the parts about the gates, such as the quoins, which require to be carefully shaped, but even so there probably would not be 150 cubic yards of masonry in the whole lock. it would probably be best to dispense with the usal balance beams, to avoid the risk of their being caught and injured by the branches of trees floating down during floods. Crabs or windlasses for opening the gates might be substituted.

At the close of the hot season, as soon as the river began to rise, the gates would be fastened open, and the water allowed to scour freely down the channel, in order to keep deep water just above and below that side of the barrier.

61st. If, as I suppose, the navigation of the open channel on the left bank would become difficult, when the depth of water over the upper part of the barrier has fallen to about three feet, it might be necessary that the tops of the lock gates should be raised to this level.

Boats going through in this, the most inconvenient state of the river, would then, after passing through the lock, have to overcome a fall of three feet in the two miles of the barrier, which would occasion a very insignificant current. As soon as the river fell below the tops of the rocks to its ordinary summer level, the passage through the lock channel would be made through still water.

62nd. I need not enter further into detail, to show how apparently simple such a way of surmounting the present obstacles to the navigation would be. Objections to it may possibly occur, when we are better acquainted with the true shape of the bed at each barrier; but I do not at present see that there are any serious difficulties of any kind connected with it.

The lock gates should be of iron, as wood would suffer from the alternate exposure to sun and water. These alternations would, however, be few, probably not more than four in the course of a year; the progress of deterioration from this process would consequently be but slow. It appears to me, therefore, to be a question, whether we ought not at

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once to put six sets of these gates in hand, in order that we may swing them this season. We might make them of teak for locks of thirty feet in width in the first instance. If necessary, iron ones could be substituted hereafter, and if a greater width were found necessary, these extempore locks would have the great advantage of being capable of unlimited expansion.

To double the dimensions of one, would only be to shift the position of the gates, and cut away a few more feet of rock.

63rd. Even if it were thought advisable hereafter to have a lock channel cut in the bank of the river round the barrier, if locks such as I have described can be so easily formed in the rock itself, and will immediately effect so great an improvement in the navigation of the river, we ought to construct them at once. Four of this kind would probably be necessary in the Enchanepully barrier; and, the gates being ready, might in all probability be completed the very first season. This would at once give us a good navigation, during the whole of certainly eight months of the year, up to where the Dewalamurree barrier begins, 340 miles from the sea. Then, having decided on a line for the canal across the neck of the bend in which that barrier lies, we might at once excavate to a small depth, and throw up a road along one side of the canal, by which goods brought down by the river from Chandah and Woonie might be carried across on carts, and transhipped into boats at Chematum. Or we might simply clear a track for this purpose, without reference to the line of the canal. This would complete the communication during eight months of the year between Woonie and the sea; and the cost of carriage from that part of Berar to Coringa by this route would be

| | | | |
|---|---|---|---|
| 430 miles water carriage, at 2 pice per ton per mile | Rs. | 4 | 8 |
| 35 miles road, at 2 annas per ton per mile.............. | ,, | 4 | 8 |
| Transhipment................................................ | ,, | 0 | 4 |
| | | 9 | 4 |
| 100 miles land carriage at 2 annas.......................... | | 17 | 0 |
| | | 26 | 4 |

This allows for the cost of the carriage of goods to Woonie from a circle of 100 miles, which would include Nutchengaum, Hingenghaut, and Nagpore within its limits. The present cost of conveying cotton from Nagpore and Berar to Bombay and Calcutta, is variously estimated at from 70 to 100 Rs.; the latter is what Mr. Tuke informs me Mr. Mansel, the late Commissioner of Nagpore, reckoned it to be.

It seems thus highly probable that in one year we might open a route for it to Coringa, by which it would be carried to the sea for one-third or one-fourth of this price, and this with a large part of the communication in a most incomplete state; the road carriage alone, which would be eventually superseded in great measure, amounting to four-fifths of this reduced rate.

64th. This mode of improving the passage through the barriers is the one, which, if feasible, I would certainly recommend for immediate adoption, without any reference to what might eventually be found necessary for this purpose.

65th. With the question of keeping up the navigation of the river during the four months of the year in which the natural supply of water is insufficient, we have at present nothing to do.

We are not yet in a position to discuss it, and it is, in fact, wholly secondary to our immediate object, which is to remove, as quickly as possible, the obstacles which now interrupt a navigation which would otherwise be practicable for two-thirds of the year. I shall not, therefore, notice it further in this place.

66th. While speaking of the physical obstruction to the navigation of this river, I would beg again to remind the Board that impediments of a far more serious nature exist, in the present unrestrained power of the Zemindars to levy tolls, to an unlimited amount, from all boats passing through their territories; and that until the whole of the present system of extortion is utterly swept away, and the course opened for a free and unfettered trade along the whole length of the river, all our other improvements will be of no avail whatever. The duties now levied by the native chieftains along the river are prohibitory of all trade, and it is in vain our attempting to create one by improving the navigation, until they are done away with.

67th. From what has been said, and from all the information we are yet in possession of respecting the Godavery, we may, I think, draw the following general conclusions.

1. That the Godavery, in its present state, is navigable during parts of four months of the year, viz. from July to October inclusive.

2. That a trifling outlay in blasting and clearing away rocks will probably add another month to this period, besides greatly reducing the length and number of the intervals during which the monsoon navigation is now interrupted. 15

3. That there is always a sufficient body of water in the river, during eight months of the year, to afford excellent navigation for steamers and boats of light draft in all the open parts of the bed.

4. That the three barriers of rock at Cintral, Enchanepully, and Dewalamurree, are the only serious obstacles to the navigation.

5. That these may be easily overcome in every instance by locks, and that in the case of the 1st two barriers, these works would probably be of so extremely simple construction, that they might be completed in the first season of operations.

6. That the practicability of maintaining an excellent navigation throughout 450 or 500 miles of the Godavery for eight months in the year, is therefore a matter of absolute certainty, and that all the information we have yet obtained renders it extremely probable, that there will be no difficulty in making good the communication, for half the year, up to Natchengaum, Hingenghaut and Nagpore.

68th. It is, perhaps, premature to attempt to form an estimate of the probable expense of perfecting the navigation, by any one of the methods above proposed, or by any combination of them.

It is, however, desirable, that we should have some idea, at the outset, of the probable limits of the expenditure required, and I therefore venture to add the following rough calculation of it. It supposes that we avoid the barriers, by canals cut round them, in the land on one side, and furnished with locks of dimensions sufficient to admit first class river steamers, the chambers being 300 feet long by 50 feet wide. Also that the canal shall be of width sufficient to allow two such steamers to pass each other.

The rate allowed for earthwork is the same as in this District, and the cost of masonry 1½ Rupees per cubic yard.

1. *Cintral Barrier.*—

| | |
|---|---|
| Earthwork........................................ | 5½ lacs. |
| Locks (total lift 36 feet)........................ | 2 |
| Total... | 7½ |

*Enchanepully Barrier.*—

| | |
|---|---|
| Earthwork........................................ | 5½ |
| Locks (total lift 50 feet)........................ | 3 |
| | 8½ |

*Dewalamurree Barrier.*—

| | |
|---|---|
| Earthwork.................................................... | 5 |
| Locks (total lift 142 feet)...................................... | 8 |
| | 13 |
| Clearing away rocks in other parts of the bed, and sundries............................................................ | 1 |
| Total... | 30 lacs. |

This does not include the cost of storing water for the summer navigation. It merely allows for making the river navigable for first class steamers, for eight months in the year.

I give this merely as an approximation. Whether we cut through the barriers or lock round them, the expense will be about the same; but if the plan of placing the locks in the barriers itself is found practicable, the cost will probably not exceed two-thirds of the amount of this estimate.

69th. I must now conclude. I find it useless to attempt to complete this report. My other duties render it quite impossible for me to give the subject that degree of consideration which it requires. I have explained the nature of the present obstructions to the navigation of the Godavery, and suggested plans for removing them. The opinions I have expressed on this subject may, on fuller consideration, require considerable modification.

I would suggest that copies of this letter should be sent to Major F. Cotton and to Col. A. Cotton, that they may be placed in possession of all the information that has been obtained during the recent exploration of the river, and be enabled to judge how far my views in the matter are correct.

I have the honor to be &c.,

F. T. HAIG, Lieut.

*Acting Civil Engineer Godavery Division.*

Rajahmundry District,
Camp at Dowlaiswaram,
*8th December*, 1854.

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## NOTES, BY Mr. G. P. TUKE, ON THE GODAVERY, FROM BYARUM UP TO BALHANPOOR.

The report of the river, in the dry season, was concluded at Byarum last year by Mr. Tuke; the same is now continued up to Balhanpoor.

*From " Byarum" to " Mungapett."*

In this portion of the river, distance twenty miles, there are shoals only to contend with, the few rocks that do exist not being of any material consequence.

It will be seen, by the report of last year, that from a mile below up to this village (Byarum), a moodagoo exists; this continues up to a small low patch of rocks, close into, and running out from right bank, to a distance of 100 yards; they commence 400 yards above the large tamarind trees above " Byarum" village, and continue, with but few spaces open (or free from rocks), up to a village not down in map (but opposite "Idraie"). At this village some of the rocks lay off the bank as far as 200 yards, and are the highest of these now called the " Byarum" batch, the highest measuring ten feet, but outside all rocks the water extends for eighty yards, when there is a very gradually sloping sand bank. These rocks cannot be deemed the slightest obstacle, *as in the course, 300 yards from bank*, all are avoided, and of course, in a very slight rise of the river, all are hidden.

One mile below Idraie, just at a very jungly part of the river bank, a small patch of rock runs out from bank ten yards; it is solitary, and attached to the bank. This has been mentioned, although it is not likely a vessel or boat would ever go near it, although the poor *Pottinger* steamer, not being able to contend with the moderate stream mid river, and driven thereby to seek every where for places where current next to nothing existed, did fall in with this rock on her voyage up river, but coming down, mid river was her course. A boat tracking up river would not find this rock in her way; she would see it, as it is a gradually sloping one.

Through the " Byarum" rocks themselves sharp currents exist, but outside them very slight, one and a half to two miles an hour, the water being from one to three feet deep.

From " Byarum" up to " Agneapullee" the right bank is very steep and woody at intervals, and shews strongly that in the freshes the strength of the current is on this side; the left bank is woody, in some places very much so, up to " Soroor."

From the upper end of the " Byarum" rocks the water runs over a shoal with from ten to fourteen inches of water, with a sharp current,

over to "Soroor;" under this village are two clumps of rocks attached to bank, and a moodagoo of water; this latter extends a quarter of a mile above "Soroor," up to a very bad shoal, not more than six inches of water over it; the river now runs into left bank, continuing very shoal, with currents from one to three miles an hour, up past "Albaka" as far as Nullagontapully (upper), where it again turns sharp over to right bank, where a moodagoo begins, and runs up to "Mungapett."

In Captain Fenwick's report rocks of some size are said to run across the river at Albaka, but if they do exist now, they must be buried by the large sand-bank, which now runs across, or nearly so. There certainly are a few rocks, under the village of Albaka, but a very small party in a week would remove all, even for the dry season navigation.

From "Soroor" upwards, to opposite "Mungapett," the left bank is woody at intervals, the right bank, from Byarum to Mungapett, very much so.

There is a large lunkah running parallel with the river opposite Albaka, its length a mile and a quarter, and of some height; the highest fresh is said to nearly cover it,—its situation nearly mid river, but rather nearer left bank.

*From "Mungapett" to "Goodicola," Distance, thirty miles.*

The water keeps close in to right bank, which is very steep, and not very woody, nearly all "moodagoo" up to the village of "Ellapoor," under which village a large, but low patch of rocks lay, the highest of them twelve feet high; they commence a little below the village and continue for 300 yards above. They are attached to bank, and the furthest of them run out 90 to 100 yards from it, with 50 yards of water beyond them, beyond which, is a low sloping sand bank.

Opposite Mungapett, and for four miles above, several lunkahs exist, which when the river is very full are covered; the course then is, down river keep close into "Ramnycorum" Village, and the right bank to "Mungapett", and after that go on so to "Byarum," but even at all times getting into right bank, inside all the lunkahs, is the best course. Banks not very woody in this part. From "Ellapoor" the river continues close into right bank, as far as "Ramnycorum;" it then turns over to "Eurogerlapullee" Village, over a bad shoal, then joins a moodagoo outside, and close to Nuggarum lunkah, and runs up to the village of "Lunkahunpully" on right bank, above which village are a few rocks, the highest fourteen or fifteen feet and laying off bank fifty yards; there is a small rocky island laying between these rocks and the village of

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"Rampooram," not down in map, but opposite "Kungulgunpoorum," very woody; the tops of the trees are said never to be covered by the highest fresh; the water runs over from the few rocks just mentioned to the left bank. In its crossing, it shoals to one foot, but a fine moodagoo begins at "Poosoor," and continues up to the island nearly opposite "Aigoorapetta." However the course of the moodagoo from "Poosoor" is close into left bank to "Chintoor," then winds across to "Kurrulpulley," then close into right bank till "Chintagoorum"; it now slopes gradually over to "Aigoorapetta," and close in under left bank, opposite the lower end of the small island. Here the moodagoo now ceases, and the water gets very narrow indeed, not more than seventy yards broad, and a small natural stone dam extends across it, with a fall of two and a half feet; there is just water enough running over it for a Sunguttee to go over. The dam is formed of small stones, which could be very easily removed, most of them by a crowbar. Above this dam, for a quarter of a mile, the water is very shallow, and currents from two to three miles an hour.

It must here be noticed that under the village of "Kirtulpulley," which was passed just now, a large rocky point exists, with several rocks laying off it, of various heights up to twenty feet, but they are not worth mentioning, for there is a fine sheet of water outside them, close to a low sand bank. All that need be said is, keep off Kirtulpully in a half fresh, in the dry season a child could take a boat up or down, keeping close to sand bank on left bank.

The Island just mentioned, and known as the "Wonagoora" Island, lays nearly mid river, but nearer left bank, is thickly wooded, but never covered with water in the highest fresh.

From a little below Wonagoora a fine moodagoo begins, it is very broad and deep, and perfectly still water apparently.

From Kirtulpully up to Goodecola both banks are very steep, but not very woody. The slack current was found to be, by the "*Pottinger*" last year, between island and left bank; from the island down to Kirtulpully, nearly mid river.

*From "Goodecola" to "Enchunpully,"—distance, nine miles.*

The broad moodagoo just mentioned still continues, and runs up to a village called "Luchmepooram" opposite a village called "Eeraveram." Neither of these are marked in the map. They are a mile and a half above "Goodecola," "Luchmepooram" on right bank, "Eeravaram" on left. Under both these villages there are rocks, those at Eeravaram being a

reef running out eighty yards, and in height twenty-four feet, with many very low ones laying close in under bank for a quarter of a mile above the village. The rocks at "Luchmepooram" are of the same description, but extending up as far as, and 300 yards above, the next village, "Davadoola" (not in map), half a mile distant from "Luchmepooram," the highest twenty feet. Close above "Luchmepooram" the moodago ceases, and a very narrow stream runs close in under left bank, with two to seven feet in it, for a distance of three quarters of a mile. A fine broad still piece of water now occurs, with the left bank rock bound, right bank very woody, the river perfectly free of rocks till within a mile of "Mooknoor" (properly Tarlagoodem), where rocks run off from left bank to nearly mid river, and some of them eighteen feet in height; this bank should be avoided unless the river is very full, but there is no occasion to go near it at any time. The strong current is evidently on this side; mid river course here would be very safe at all stages of the river. These rocks continue up to Tarlagoodem, under which village lay two large clumps of rocks, off the bank 100 yards, with many smaller ones about them. The two high clumps are of twenty-five and thirty feet high; opposite these is the place where the great whirlpool is said to exist by Captain Fenwick, and of which much has been before said in the *Pottinger's* journal of last year. At the whirlpool site a large reef of rocks exist. They are the foot of a hill, which runs down here to the waters edge, and runs out into the water to a distance of ninety yards, with a gradual slope. The reef is 200 yards in breadth, the lower side of the reef is quite even and smooth, with a hole of great depth, and thirty to forty yards broad, close under it, below which hole a very high sand bank is thrown up. Between this reef, which measured at water's edge fourteen feet high, and the two clumps of rocks under Tarlagoodem, not a rock is to be seen; the moodagoo still continues, but from the right bank to the left studded with rocks, the highest, however, being on right side; the water is very deep, and in the dry season a boat would have no difficulty in getting up this part. The rocks on left bank are low, with but few exceptions, which are rocks of fifteen to eighteen feet in height; but one reef attached to bank is more than twenty feet; it runs out sixty yards. Opposite "Teemit" the moodagoo ceases, and a shoal with not more than one foot of water commences, and runs up, for 200 yards, close into left bank, with one or two small rocks in it; a deep moodagoo again begins at the head of this shoal, close in under left bank, and runs up to opposite "Enchunpully." The breadth of this moodagoo is 90 to 100 yards, and is inside a large reef of rocks, directly opposite Enchunpully, and of twenty-five to thirty feet in height. The whole way up, from whirl-

pool point to Enchunpully, from right bank to out much more than mid river, is one bed of rocks, varying in height from ten to twenty-three feet; right bank open, left bank rock-bound and wooded.

*From "Enchunpully" to "Goomulcondah."*

This part of the river is rather bad, on account of the large rocks in it. After leaving the large reef directly oposite Enchunpully, you proceed along the moodagoo, which is still close to left bank, and free of rocks for 200 yards, when you enter a deep channel, through a bed of very high rocks, extending nearly from one bank to the other, their average height twenty-five feet, but close into left bank not more than eighteen to twenty feet, till you arrive at "Doodiara," where they are again very high; the channel, after entering it, gradually strikes over to near right bank, that is within 100 yards of it, and then goes straight up past "Neelumpully."

This channel is certainly a very striking one; it is in breadth thirty to forty yards, and not a rock to be seen in it; little or no current in it, and its sides as smooth as if cut by a chisel; it looks as if it had been cut out by hand. Through this bed of rocks just mentioned, the channel continues so up to "Neelumpully," opposite which village a small natural stone dam runs across it, with a fall of two feet, and a very rapid current; above this dam, at a distance of 150 yards, a moodagoo again commences, and the rock bed ceases, with from three to seven feet water; the rocks on right bank are high for 200 yards above "Neelumpully;" rocks on left bank are high, and continue so some way above "Doodiara;" these latter also lay out some distance from the bank; this moodagoo runs as far as opposite "Kumbulpetta," where the water inclines to right bank, and narrows to forty yards, beginning with a natural stone dam with a fall of seven feet, above this dam the channel is very straight, through small rocks of six to nine feet in height; right bank is now nearly clear of rocks, but a few on left bank; this narrow channel extends for 400 yards, where another broad deep moodagoo commences, which runs up to the junction of the Indravatty, with rocks of from fifteen to twenty feet, here and there, near either bank, but a good passage mid river till within two miles of the Indravatty junction, where again a bed of rocks exists, similar to the bed between "Neelumpully" and "Enchumpully," with a channel through it of precisely the same nature. This bed ceases again within 200 yards of the Indravatty, but scattered rocks exist, varying in height from fifteen to twenty-five feet, a good passage through them, but not straight, therefore intricate. At the junction a bed of rocks stretches across the "Godavery" branch, nearly

from one bank to the other, not quite to right bank. The rocks are of great height, but a channel, quite similar to the beautiful ones mentioned as existing at the Neelumpully rocks, and the one near the Indravatty, runs through the rock bed for a distance of 150 yards, where there is a fall over rocks of seventeen or eighteen feet; above this fall for a distance of ninety yards, the water has another, but very gradual fall; the water then broadens out, and is studded with small rocks, from one bank to the other; the large fall of seventeen or eighteen feet, is a very sudden one, all within twelve yards; forty yards above is one large patch of rock, eighteen feet above all others; the left bank is very rocky just here, the right could be cleared of rocks, at a very small expense, for navigation during the freshes: for the dry season a double lock could be placed at the great fall for next to nothing, the excavation is already made, foundations likewise, as much teak wood as necessary in Mr. Palmer's wood store, within three miles, with good water carriage; chunam on the bank; all wanted is a little money, a set of masons to build simple walls for lock, and carpenters from Mahadaepoor, to make the lock gates; a very few yards of masonry would close up the few openings in the rocks, which now prevent it being said that there is now an annicut across. However, we have just left the high rock close above the fall of eighteen feet. Above this said rock, for a distance of one mile, the river bed is studded with rocks of various sizes, from two to eighteen feet, but few only on right bank; you now leave rocks, and the water shoals and runs close into left bank, and continues so up to within half a mile of "Punkanah," a village on right bank (not down in map), but distant from Dammoor one and a half miles, where there is a small natural stone dam across the present water, of sixty yards broad, with a fall (sudden) of seven feet. Above this the water broadens out into a moodagoo up to "Punkanah village," above which it shoals to from eight to eighteen inches, narrows very much, and keeps near right hand bank. The shoal water continues for half a mile, then enters another moodagoo, which extends past the right between "Lunkulgudda" and "Wooragoora" (upper); opposite the former village, close in and laying out from left bank to a distance of eighty yards, are a few rocks, the highest fourteen feet. Opposite "Wooragoora" upper (for there are two Wooragooras), the river shoals and runs over close to right bank, then over again to left bank into "Assoorelle," then keeps close in to ditto, being very shoal and narrow as far as opposite "Bigloor;" then crosses over gradually into a moodagoo close under right bank. At "Mahadaepoor" a small patch of low rocks, highest ten feet, and at-

tached to right bank, run out from it for a distance of 100 yards, at a corner directly opposite Assoorellee.

*From "Mahadaepoor" to "Soopak"—Distance, thirty-three miles.*

From "Mahadaepoor" the water runs over in a gradual slope to left bank, and continues so till nearly opposite the village of "Mulpullee," where it slopes over again into a large moodagoo a little above "Mulpullee," close under right bank. This "moodagoo" runs up to a clump of rocks a quarter of mile below "Kowlaisheram" a village at the entrance and on right bank of the branching off of the Godavery: these rocks are fifteen feet high, some attached to bank, some laying out as far as seventy yards from bank.

You now go over a piece of shoal water of 300 yards in length, with from ten to fifteen inches of water, and again enter a large moodagoo, which extends for half a mile above "Sironcha," where there is a small shoal of forty yards in length.

A very small stream indeed runs out of Godavery branch, its breadth fifteen yards, depth eight inches.

At the village of "Nugrum" are a few batches of rocks, running out in reefs, to a distance of forty yards from bank; they are three in number, but not worth mentioning. At "Sironcha," close above the fort, there is also a large and high clump of rocks, but they are close in to bank. At a point 300 yards above the fort, there is also a reef of rocks, high at bank, but slopes down to nothing at water's edge. Below this a whirlpool is said to exist, but not a dangerous one; however, there is room enough either mid river or close to right bank, which is quite clear, being a sandy bottom. After passing the shoal just said to exist a quarter of a mile above "Sironcha," you again get into a moodagoo, and carry it up to a little past "Kota," where the river shoals and runs close in under right bank.

From "Mahadeapoor" up to "Kota" both banks are very much wooded.

The shoals continue, with but few intermissions of moodagoos, up to the village, in fact, a mile beyond "Tekera," where another moodagoo begins und runs up to "Alah," where it ceases, and the river runs over close to right bank, being very shoal, with strong currents, and continues so for a mile and a half above "Soopak." One small solitary rock lays 200 yards below "Soopak," 150 yards off shore; it is very small and not more than three feet high. From "Kota" up to "Soopak" the banks are nearly free of jungle.

*From "Soopak" to "Dawulmurree"—Distance, forty-three miles by Map.*

It is said by map, for, as far as could be judged, the real distance is not much more than half what the map says, and has been so from Mahadeapoor upwards; it agreed with what natives would point out, but their koss is only one mile in real distance.

From getting into the moodagoo a mile and a half above "Soopak" up to "Chummatum" it is almost all moodagoo, but shoals intervene now and then, banks steep, and nearly free of jungle; a quarter of a mile below "Amunpully" a patch of rocks, in height fifteen feet, occur, they are attached to bank, and run off seventy yards from it.

There are a few loose rocks, or rather stones, laying close under bank at "Chummatum;" this village is not down in map, but is nearly opposite "Oyalpatch."

*From "Chummatum" to "Jillara"—Distance, sixteen miles.*

The river is mostly all moodagoo up to Jillara river, but few shoals occur; a quarter of a mile above "Lunkah chain" a small batch of rocks, eight feet high, lay 200 yards off left bank. From this batch of rocks up to near the "Jillara" river rocks frequently occur, running out from both banks, but mid river quite free from them; the banks are open. The situation of the river of "Jillara" is a quarter of a mile below that village; there is a village on its right bank called "Mutlagoodum;" this river has no name by the natives, it is of 120 yards in breadth and is said to run up to the great cotton mart "Junagaum," near "Sipoor". At this river mouth the river shoals very much, water being close in under right bank, and is very shoal nearly all the way up to "Moorelgoodum," a village called "Booragoorum" in map; under this village a large patch of rocks lay close under bank, and laying out from it 100 yards; a few rocks also under left bank opposite here; mid-river is the course here.

From Moorelgoodum a moodagoo extends up to Dawulmurree; there are small hills on either side of the river, which slope gradually down to water edge; the river here very narrow and straight. A mile below Dawulmurree however, it takes a turn to the right. However just before the turn a reef of rocks, in height ten feet, lays nearly mid river, but rather nearer left bank; it runs parallel with river, its length eighty yards, and very narrow. A little above, and rather near right bank, there is a small reef, of four or five feet high, with three small single rocks close above it.

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Opposite the village of "Tellair," not down in the map, (it is directly at the upper end of the small hill of right bank, or where the jungle ceases on upper dide,) there is one narrow reef of rock, twenty feet high, mid river, running parallel with river, on the left bank opposite Tellare, the small hill runs down and into river, seventy or eighty yards, in a reef. From this reef, nearly up to "Dawulmurree," several high rocks lay near left bank. A vessel coming down here should therefore hug the shore of "Tellare" close, till past jungle, then strike off to mid river again, thereby avoiding a few rocks, which lay close under right bank: 150 yards below jungle, and 100 yards below "Dawulmurree," the water again shoals.

From "Dawulmurree" to "Chinsogundie," or "Chinahegundoo," distance six and a half miles, per map. Close under the village of "Dawulmurree" lays a small reef of rocks sloping from bank, but does not run out more than fifty yards; 200 yards above here, and mid river, is one small rock, four feet high.

The water is now very shoal, with strong currents. On the right bank, three quarters of a mile above "Dawulmurree," is a small village called "Mogolee," (not down in map) a quarter of a mile below which village, there are several clumps of rocks, in height from ten to fifteen feet. They run out from bank to a distance of 150 or 200 yards, but mid river free of rocks, and the sand banks very low, banks open.

Close above "Mogolee," rocks commence, and stud the river bed, the highest extend from right bank to more than mid river, their height eighteen feet; the rocks on left side of river are low, with the exception of a high one here and there, but nothing to impede navigation if they were buoyed, even without blasting. There is a fine open channel through all the rocks near right bank, not parallel with bank; this channel commences at lower end of "Chinsogundee" island, and runs gradually into right bank, opposite lower end of island. There is a large patch of high rocks attached to left bank, and running out 100 yards from it, there is lots of room outside this reef. Between right bank and island high rocks from the river bed, between left bank and island very small ones. The water is deep through these rocks; and, with the exception of three falls (sudden) moodagoo.

In this last named piece of river, avoid right bank.

*From "Chinsogundee" to "Boree,"—Distance, eight miles.*

From "Chinsogundee" the river still maintains the same nature as just mentioned, right banks to mid river full of high rocks, left bank

nearly clear of rocks of any size, the few exceptions are as follow. Close above the village of "Chinsogundee," at a very woody point, are some rocks, twenty feet high, attached to left bank, and extending into river bed 90 yards; at "Wungapillee" some large rocks are attached to bank and run out 100 yards, they are situated directly opposite a large single tree at lower end of village. The next exception begins 200 yards below the village of "Mahagaum," and extends 200 yards above village; it consists of high rocks attached to and running out 150 yards from bank, the highest of these rocks are from twenty to twenty-two feet.

Opposite Mahagaum, there is a small island, very woody, it is nearly mid river, but nearest to right bank; the best channel is mid way between this island and "Mahagaum," the rocks not measuring higher than ten to twelve feet high, with, of course, a few exceptions, which must either be buoyed or blasted.

The water scattered all through these rocks, if confined to one channel, would supply plenty for navigation in the dry season.

From 200 yards above "Mahagaum" up to the Boree river, the left side of river has only very small rocks in it; the right bank has high ones, but a good channel through them; most of the water is on right bank. From the Boree river up to Boree many rocks of from fifteen to eighteen feet are scattered in river bed between left bank and "Coorta" lunkah, (map not quite correct here), but between right bank and "Coorta" lunkah a beautiful deep channel, with but few rocks in it. In this channel is a village on right bank, called "Demmida," it is directly opposite two large tamarind trees on "Coorta" lunkah; under this village, and for 200 yards above it, are a few rocks, of fourteen or fifteen feet high, attached to bank, and one or two of them laying off at forty yards. A vessel going up this channel should enter it nearly mid way, as a rocky reef runs off right river bank; in fact, it would be shorter to say, keep within seventy yards of lower end of lunkah, and steer for "Demmida" direct till close to it, then keep out from bank sixty yards till 200 yards above it, then close into right bank again, thereby avoiding a few high rocks attached to "Coorta" lunkah; at the head of this channel some little blasting would be required, as there are a few rocks wich measure eighteen and twenty feet.

The water in this channel, now called "Demmida" channel, was eight and nine feet deep, and still; lunkah bank woody, right river bank pretty open.

From the lower end of Coorta lunkah straight to the first large tree out of "Mahagaum," on upper side, a straight line occurs free of rocks,

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with the exception of one patch 200 yards below lunkah, which is eight or ten feet high, the breadth of this straight line seventy to eighty yards broad.

*From "Boree" to "Chimnee Lunkah" head—Distance, seventeen miles.*

After leaving "Boree," some large rocks lay on left bank up to "Alah," many of them extending out mid river, but there are not many whose height exceeds fourteen or fifteen feet. After leaving the head of the "Demmida" channel, as said before, rocky, the right bank has, with a few exceptions, only small rocks, and continues so to mid river; this bank is very woody, the left one more open; the water is much scattered through these rocks, with no regular channel through them.

From "Alah" high rocks abound on left bank, and mid-river also, the right bank containing only small ones, with a few exceptions, but at the lunkah (lower end) opposite "Muchakut" the rocks between left bank and lunkah are in height from fifteen to twenty-five feet, and are not scattered so, but in a complete mass, and with very few intermissions remain so up to near "Koongurra"; there is little or no water running through them. Between "Muchakut lunkah," and right bank, up to head of "Chimnee" lunkah, the rocks are much smaller, except in a few places, where either blasting or buoying would be required; much water runs down this right side of Lunkah, although much scattered. There is, by map, one lunkah opposite "Koongurra", but there are actually two lunkahs, right bank lunkah, between which and right river bank the rocks are scarcely worth mentioning till the head of this lunkah, where the two rivers branch off; where attached to right bank, and running off 100 yards, is a reef of high rocks, but outside this reef rocks quite low.

A vessel coming down river, that is from the Chandah river, should keep off this point, and after passing it 200 yards get close in to right bank again.

From "Chimnee," the Chandah branch of river bed is very rocky, but rocks of no size.

From the reef just mentioned as running off right bank at junction, the rocks on right banks extend to more than mid-river, but do not exceed ten to twelve feet in height; but close under left bank, abreast of "Chimnee," there are four whose height are from fifteen to eighteen feet.

On the left bank, a quarter of a mile above these four rocks, stands a solitary Palmyra tree, opposite which a complete reef runs across, very like as if an annicut had been built there, but at either end of this annicut reef the rocks are high, but only so close into banks; they do not extend out from bank more than sixty yards, and at most measure fifteen feet;

the other parts of annicut are very low, and the water escapes only over one part of it, namely a small space mid river; much water stands above it. A fine place for a wall to be built on the top of this reef, as an annicut no foundation required, no apron either, nature has given all. Lime abundant on banks.

From this, now called the "Chimnee" annicut reef, up to "Nundwara" village, nothing but a few small rocks, or perhaps, more properly, called stones, stud a fine deep still piece of water, the whole river breadth, perhaps 300 yards broad.

Under the village of Nundwara, rocks of from twelve to sixteen feet again commence, but only of this height on left bank, and out from it to two-thirds river, right bank having but a very few higher than six and seven feet, till half a mile above "Nundwara," when a large patch of rocks, some measuring eighteen feet, lays close under right bank; mid river clear, opposite this last mentioned patch; from here rocks are quite low, three to four feet at most, up to "Dharoor" annicut reef, water scattered over whole breadth of river, averaging four to five feet deep and little or no current, banks very open.

The reef which forms the Dharoor annicut is the commencement of a bed of rocks, which begins close under the village of "Dharoor," and extends a mile and a half above village.

The annicut reef stretches from one bank to the other, with the water falling over it on the "Dharoor" side, within seventy yards of bank; there is a fall of eight feet from the water above the annicut, to the water below it; on looking up from the annicut, the rocks appear to be perfectly level, with the exception of one large patch measuring fourteen or fifteen feet, laying under right bank half a mile above "Dharoor," the water dribbles through this rocky bed in small streams, but there is no regular channel through it. The banks for a mile and a half above "Dharoor" are very woody on both sides. The rocks now disappear simultaneously with the woody bank, the breaking off of the rocks is very singular, one straight line across the river, above which a beautiful lake with open banks.

The river continues in this way to within half a mile of "Sooknoor, where close in under left bank, there is a small patch of rocks, the farthest forty yards off bank; they are scarcely worth mentioning. A little above "Kermery" there is a broad shallow river, which runs in to the Wurdah three fourths of a mile above "Sooknoor." There is one shoal nearly mid river, but with very little fall over it, the shallowest part one foot, and is of 150 yards in extent, beyond this still deep water again.

Under "Poorsa," close into right bank, there is one small rock; still, deep, and broad water, and continues so to abreast the village of Toomta, where there are six rocks laying across the river, the highest eight feet, laying within sixty yards of right bank, the smallest two feet high, about the same distance from left bank; keeping close to either bank is quite safe. For a mile above these rocks the water continues deep and broad, where it begins to shoal to three or four feet, and running close in under right bank, narrows to twenty yards. This begins at a turn of the river, which brings you into the straight reach up to the "Lanthee," in this turn mid river, lays one small solitary rock, twelve feet high, either bank may be hugged here to avoid it. It has just been said that the water narrows very much, it does so for 200 yards, where it again gets broad, and three to four feet water, and so up to "Chinkola." From Chinkola to Dharoor the water gets very shoal, some places only ten inches deep, and continues shoal till Dharoor, where there is a fine deep still piece of water, and remains so up to a quarter of a mile above Togaum, where there is a large batch of rocks on right bank, under village, (name not known): it now shoals again, and continues so to near a large banyan tree on left bank, three quarters of a mile below "Pussouree," where there is a small moodagoo; shoals again, and narrows very much; in this way it remains to a woody part of left bank, near "Kataree," where a fine moodagoo again occurs, with some small rock close into left bank. This moodagoo lasts till opposite "Urmeree," where it shoals; but not badly, up to river Kirrmully, (a quarter of a mile below). There again fine still water, which reaches up to a batch of rocks under the village of "Dahally;" these rocks are close into left bank, and are of an ochre colour; the river now shoals again, does so up to "Doodhally," where it gets still, but not more than one and a half feet water, it is now shoal up to within one mile of "Bulhanpoor," where a fine deep moodagoo commences again.

(Signed) G. P. T[illegible]E.

Dowlaiswaram,
15*th October*, 1854.

(True Copy)

F. T. HAIG, Lieut.

*Acting Civil Engineer Godavery Division.*

GOVT LITHOGRAPHIC PRESS, CENTRAL OFFICE OF P.W. FORT ST GEORGE.

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